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## Dwarfmistletoe on True Firs in California

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The dwarfmistletoe (*Arceuthobium campylopodium* Engelm. forma *abietinum* (Engelm.) Gill) is a widespread and destructive parasite of red fir (*Abies magnifica* A. Murr.) and white fir (*A. concolor* (Gord. and Glend.) Lindl.) in California. In the State's commercial forests, these two firs include nearly one-fourth of the timber volume and provide about one-seventh of the lumber produced. Forest disease surveys conducted by the Forest Service from 1958-1961 show that about 40 percent of the red fir stands and 30 percent of the white fir stands are infested with the parasite. Until recently a single form of dwarf-

mistletoe was thought to attack both fir species indiscriminately. It is now known to include two host-specific dwarfmistletoes: one growing only on red fir, and one only on white fir.

### Description and Life History

Dwarfmistletoes of true firs, like all members of the genus, are parasitic, seed-bearing plants. They have a specialized, rootlike, nutrient-absorbing system that grows within the host tissues and an aerial shoot system that arises from within the host branch (fig. 1).

The aerial system of the plant consists of small, leafless, jointed, green to yellowish-brown shoots. Mature shoots seldom are longer than 6 to 8 inches. Although shoots contain chlorophyll and elaborate some of their own carbohydrates,

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Figure 1.—Dwarfmistletoe plant growing on branch of white fir. Note the aerial shoots arising from the bark and the swollen portion of the branch that contains the parasite's internal rootlike system.

the parasite gets most of its nutrients from living tissues of the host through the specialized rootlike system.

The primary function of the aerial shoots is reproduction. Male flowers (fig. 2) and female flowers

are produced on separate plants. Small, inconspicuous flowers arise from the joints of the shoot segments. Plants bloom in July and August and apparently are insect pollinated. After flowering, the male flowers and often the male



Figure 2.—Shoot of dwarfmistletoe on red fir bearing mature male flowers.

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shoots die and fall from the plant. The fertilized female flowers remain on the shoots over winter, and produce fruit (fig. 3) the next year. Seed dispersal occurs in September and October. The female shoots do not die after seed dispersal; they

may persist for several years and produce more than one crop of fruit.

Dwarfmistletoe seeds, usually one per fruit, are explosively discharged from the fruit. Unlike the seeds of the true mistletoes, they are

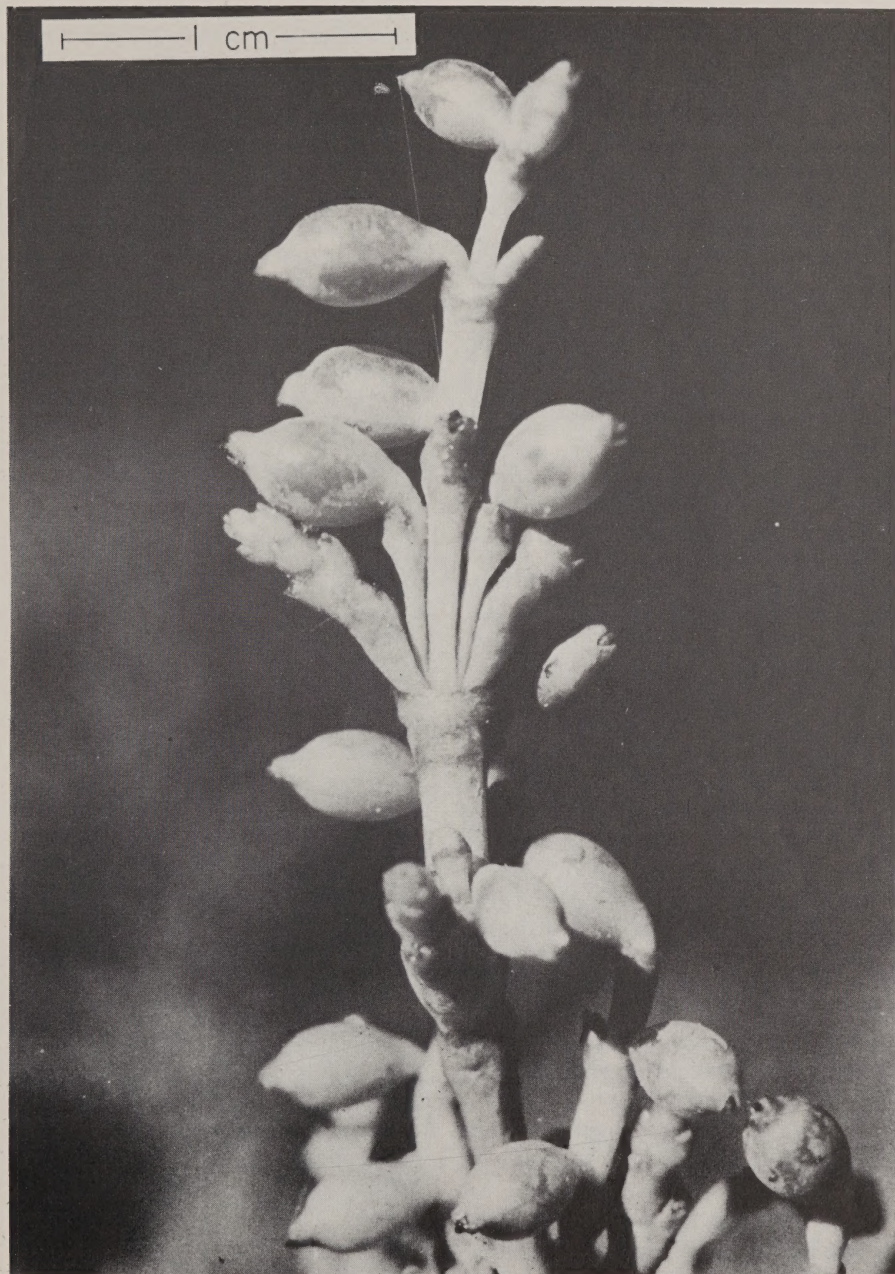


Figure 3.—Shoot of dwarfmistletoe on red fir bearing mature fruit.

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not disseminated by birds and animals. Discharged upward and outward from the tree, dwarfmistletoe seeds may travel a maximum horizontal distance of about 50 feet. Because of the influence of wind, seeds dispersed from plants in the tops of tall trees travel greater distances than seeds discharged closer to the ground.

Viscin, a sticky mucilaginous substance, covers the surface of the seeds, enabling them to stick to objects they may strike. Needles are the primary receptors. During fall and winter rains, seeds that have adhered to needles, swell, become slippery, and slide down the needles, radicle end first, to a branch. In this manner they become located on branches at the base of needles.

Germination occurs in spring. The radicle grows along the surface of a branch until it contacts an obstruction, often a needle base or a branch fork. The radicle, when inhibited in linear growth, forms at its apex a mound of tissue, commonly known as a "holdfast." The holdfast attaches the radicle securely to the branch. It also initiates a rootlike structure that penetrates the branch and establishes a new infection. Radicles not forming holdfasts continue linear growth until their food supply is exhausted.

After seed dispersal, a period of 2 to 5 years is necessary before shoots of the parasite appear. New shoots often bear flowers the year they arise, and produce fruit the following year. In general, the entire life cycle of a male dwarfmistletoe plant on true firs, which is about a year less than that of a female plant, is at least 4 years but more often 5 or 6 years.

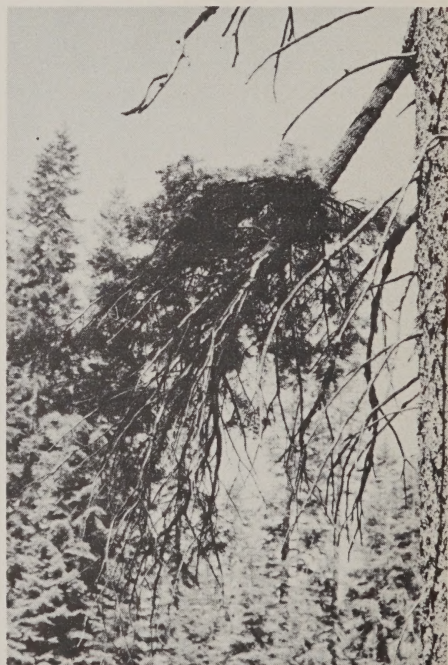
### Symptoms and Signs of Infection

*Shoots* of the parasite (fig. 1) are the best sign of infection. On young infections, they tend to arise in clumps near the center of swol-

len branch tissue. On old infections, they usually arise as scattered shoots at the margins of swelling.

*Swelling* of a branch is nearly always the first symptom of infection. Localized swelling initially is quite pronounced, and the infected portion of the branch becomes more or less spindle-shaped (fig. 1). The spindle-shaped appearance becomes less conspicuous as the infection gets older.

*Witches'-brooms* occasionally are associated with old infections on firs. Broomed branches are loosely arranged masses of twigs and foliage and are especially conspicuous in the lower crowns of older trees (fig. 4). These brooms persist for many years. Dwarfmistletoe brooms are readily distinguished from the tight, ball-shaped, "yellow brooms" caused by the rust fungus, *Melampsorella caryophyllacearum* Schroet. which infects red and white firs in California.

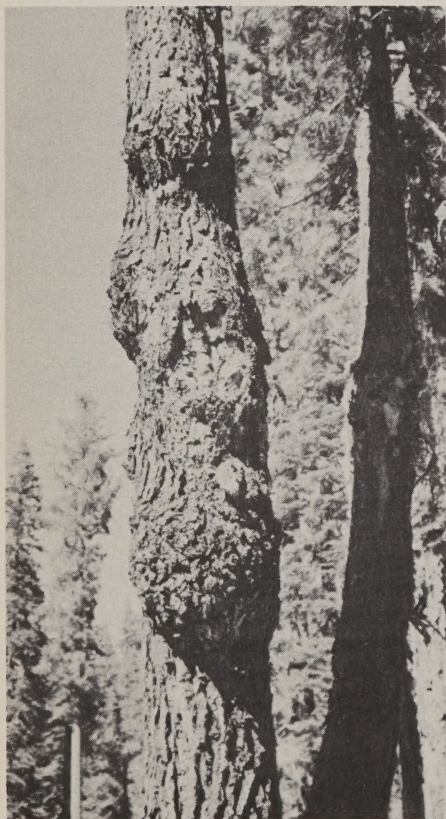


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Figure 4.—Witches'-broom caused by dwarfmistletoe on red fir. Note scattered dead branches probably killed by the canker fungus *Cytospora abietis*.

*Flags* are common in dwarf-mistletoe-infected firs, particularly red fir. Flags are caused by canker-forming fungi, most commonly *Cytospora abietis* Sacc., which invade dwarfmistletoe swellings and kill the host branches during the dormant season. In spring the foliage on dead branches turns reddish brown, forming flags that persist throughout the year.

*Bole swellings*, occasionally referred to as "burls," result from infections of the main stems of firs (fig. 5). Most common on older trees, they indicate old infections. Swellings may attain a diameter of more than twice that of the tree trunk. Often the bark sloughs from old swellings, providing an opening for insects and decay fungi.



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Figure 5.—Bole swelling of red fir caused by dwarfmistletoe. Multiple swellings were the result of several infections of the main stem.

## Damage

Damage to firs by dwarfmistletoe is extensive but not always spectacular. Trees of all ages may be reduced in growth, deformed, or killed. Reduction of tree vigor as a result of infection causes height and diameter growth to slow down. This reduction in growth results in a greater loss of timber volume than does mortality from dwarfmistletoe in fir stands.

Losses also occur from infections of the main stem. Often large bole swellings must be "bucked out" during logging. Sometimes logs with a single decayed or large bole swelling are unmerchantable.

Quality of the merchantable timber may also be reduced. Knots tend to be larger and more numerous in lumber from infected trees. Brashy wood and abnormal grain are associated with bole infections of dwarfmistletoe. Quality is also reduced by stain and decay fungi which enter the tree through bole infections.

Dwarfmistletoe can kill trees, particularly seedlings and young saplings. Death of older trees often is a result of the gradual reduction of tree vigor by the parasite and by canker fungi that invade swellings and kill branches. Weakened trees are likely to die during the occasional severe drought years characteristic of California. Overmature trees may break at decayed bole swellings (fig. 6).

## Control

*Silvicultural treatment* by removal and pruning of infected trees to eradicate dwarfmistletoe, is at present the only practical method of controlling this parasite in pure fir stands. Two approaches to dwarfmistletoe control through eradication may be used:

- (1) Stands comprised of heavily infected, even-aged, old-growth trees may be clear cut and allowed



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Figure 6.—Broken tree caused by decay of main stem at a dwarfmistletoe bole swelling. Trees of this type present a hazard in campgrounds and recreation areas.

to regenerate naturally or, if necessary, may be replanted. Infected understory trees remaining after the cutting should be pruned or removed.

(2) Merchantable trees in uneven-aged stands may be harvested and the residual stand thinned and pruned to remove infections. To eradicate the parasite by pruning,

cut off the infected branch at least an inch below the proximal extent of branch swelling. Two additional prunings should be made at 3-year intervals after the first pruning to eradicate latent infections. Thereafter, the area should be spot checked periodically for missed infections.

Once dwarfmistletoe has been completely eradicated, very little further control will be needed because reinfection from adjacent areas takes place very slowly. Partial eradication requires periodic examination of the area and possibly additional control operations to keep the parasite in check.

Avoid partial cutting of infected pure fir stands unless the procedure is part of a plan to eradicate the parasite. Opening a stand by cutting promotes vigorous growth of the parasite and facilitates its spread into residual trees.

Species conversion may also be used to control dwarfmistletoe in true firs. In mixed conifer stands where only one fir species is infected, a sound approach is to use a silvicultural method or cutting practice that encourages regeneration of the nonsusceptible fir or other coniferous species. In certain stands the task may be accomplished simply by harvesting all infected merchantable trees, leaving the nonsusceptible species to regenerate the area. In other stands removal of the infected understory trees may be necessary after harvesting the infected overstory.

In intensively used recreation areas, such as campgrounds, control of dwarfmistletoe without removing trees may be desirable. The increased longevity that results from pruning infections from these high value trees may alone justify the expense of control. Sometimes, though, removal of large trees with

decayed bole swellings is essential. As figure 4 illustrates, these trees often break at the decayed portion of the bole and therefore present a serious hazard on such areas as campgrounds and cabin sites.

*Biological agents* control dwarfmistletoe to a limited extent. Canker fungi, such as *Cytospora abietis*, invade swellings and kill both the parasite and the branch. Other fungi attack the aerial shoots of the plant or destroy the fruit and seeds. Certain insects feed on dwarfmistletoe shoots, and rodents chew the swollen tissues of infected branches. In nature, control of dwarfmistletoe by these agents is sporadic and unreliable. Research is being conducted on how to enhance the use of certain organisms, particularly insects and fungi, for biological control.

*Herbicides* that will kill the parasite without injuring the host are not yet being used operationally to control dwarfmistletoe. Such materials are being tested, however, and show some promise as a method of control, especially if branch or bole infections can be sprayed directly and if cutting or pruning infected trees is not acceptable.

## References

- FOREST PEST CONDITIONS IN CALIFORNIA. ANONYMOUS. Official Report of the Forest Pest Control Action Council. Sacramento, Calif. 1961.
- DWARFMISTLETOES OF CALIFORNIA AND THEIR CONTROL. J. W. KIMMEY. U.S. Forest Serv. Calif. Forest & Range Expt. Sta. Tech. Paper 19. 1957.
- DWARFMISTLETOE ON RED AND WHITE FIR IN CALIFORNIA. J. R. PARMETER and R. F. SCHARPF. Jour. Forestry 61: 371-374. 1963.

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